We claim:

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1. Apparatus for increasing the sensitivity of measuring the amount of radioactive material in waste utilizing localized neutron coincidence vetoes to reduce the interference caused by cosmic ray generated neutrons, said apparatus comprising:

    a) a plurality of neutron detectors, each of said detectors including means for generating a pulse in response to the detection of a neutron; and

    b) means, coupled to each of said neutron detectors, for counting only some of said pulses from each of said detectors, whether cosmic ray or fission generated, said means for counting including means that, after counting one of said pulses from a given one said detectors, vetos the counting of additional ones of said pulses for a prescribed period of time from said given one of said detectors without vetoing all of said pulses from all of said detectors.

2. The apparatus of claim 1, wherein said prescribed period of time is between 50 and 200 μs .

3. The apparatus of claim 2, wherein said prescribed period of time is 128μs.

4. The apparatus of claim 1, wherein said veto means is an electronic circuit.

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5. The apparatus of claim 4, wherein said veto means includes a leading edge pulse generator which passes said one of said pulses but blocks any subsequent pulse from said given one of said detectors for a period of between 50 and 200μs.

6. The apparatus of claim 1, wherein said veto means is a software program.

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7. The apparatus of claim 6, wherein said software program includes means for tagging each of said pulses from each of said detectors for both time and position, means for counting one of said pulses from a particular position, and means for rejecting those of said pulses which originate from said particular position and in a time interval on the order of the neutron die-away time in polyethylene or other suitable material.

8. The apparatus of claim 1, wherein said neutron detectors are grouped in pods.

9. The apparatus of claim 8, further including a plurality of means for counting and a like plurality of veto means, and wherein all said detectors included in a particular one of said pods are coupled to a one of said plurality of means for counting and to one of said veto means, said veto means vetoing said counting of said additional ones of said pulses from all of said detectors included in said pod

10. The apparatus of claim 9, further including means for vetoing said counting of said additional ones of said pulses from all of said detectors included in each of said pods which are adjacent to said pod which includes said detector which produced said pulse which was counted.

11. The apparatus of claim 8, wherein there are at least 10 of said pods.

12. The apparatus of claim 1, wherein said detectors are supported by a layer of material which shields said waste from neutrons generated outside of said layer.

13. The apparatus of claim 1, further including means for disabling said veto means for high counting rates.

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14. A method for increasing the sensitivity of measuring the amount of radioactivity in waste utilizing localized neutron coincidence vetoes to reduce the interference caused by

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cosmic ray generated neutrons, said method including the steps of:

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a) providing a plurality of neutron detectors;

b) generating pulses from each of said neutron detectors in response to the detection of neutrons by each said neutron detector, each of said pulses corresponding to the detection of a neutron;

c) for each neutron detector counting one of said pulses; and

c) for each of said neutron detectors, after said counting of said one of said pulses, vetoing the counting of additional ones of said pulses for a prescribed period of time.

15. The method of claim 14 wherein said prescribed period of time is between 50 and 200μs.

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16. The method of claim 14, wherein after said counting of said one of said pulses, also vetoing the counting of additional ones of said pulses for said prescribed period of time from detectors adjust to said detector for which said pulse was counted.

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between the sample and the individual detector modules, the probability of detecting two or more neutrons in the same module is acceptably small (about 10%), so the ability to count the plutonium source neutrons is only reduced by 10-20%.

With reference to Figure 1, detector 11 includes a bottom 13, a top (not shown), three fixed side sections generally designated 15, and a door section 17. These components define a cavity 19 in which a box 21, or a 200 liter drum 22 (or other suitable container) holding waster material is placed for detection of plutonium and other transuranic materials. (Though both the drum and the box are illustrated, only one or the other would be in cavity 19 at any one time.) While an air gap is illustrated between box 21 and the interior walls of cavity 19, none is required. Conversely, there is no maximum air gap. The waste container can be made of any material, including steel, wood, plastic, and cardboard. (The material in the waste container may also include steel, plastic, wood and cardboard.) Surrounding the top, bottom 13, and sides 15 is a layer of polyethylene 23. Door 17 is also covered with a layer of polyethylene 25. To remove cosmic ray generated neutrons that are external to detector 11, layers 23 and 25 are, approximately, 6 inches thick. As indicated by arrow 27, door 17 slides sideways. As they form no part of the present invention, the mechanisms for supporting and opening and closing door 17 are not disclosed.

As is also shown in Figure 1, detector 11 includes a plurality of detector veto pods 31 (or modules), a few of which are illustrated. In the preferred embodiment there are a total of 52 pods, 22 pods are included in sides 15; 10 pods, in door 17; and 10 pods in each of the top and bottom 13. Each pod 31 includes 5 detector tubes 33 embedded in polyethylene casing 15 ~~35~~. For convenience of illustration, each pod is shown as having only 3 tubes 33. As those

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skilled in the art will appreciate, the number of tubes per pod and the number of pods can be varied. The greater the number of tubes surrounding a cavity of a given size, the greater the efficiency of the design. However, increasing the number of tubes (whether tubes per pod, or pods) increases the cost of the detector. As those skilled in the art will also appreciate, each tube 33 includes a casing (not shown), an anode wire (also not shown) and is filled with ^3He. Each anode wire is connected to a source of high voltage, a capacitor and a resistance. As this arrangement is well known in the art it has not been illustrated. As is also well known, the ionization resulting from a thermal neutron colliding with a ^3He molecule produces a voltage pulse.

The LCV circuitry of the present invention is illustrated in Figures 2 and 3. The voltage pulses from each of the 5 ^3He filled tubes 33 of each pod 31 are connected to, for instance, preamp 41_1 which amplifies the voltage pulses and transmits them to the LCV (or veto) circuit 43_1. In the preferred embodiment AMPTEK model A111 preamps are used. The signal from preamp 41_1 is fed to veto circuit 43_1. Circuit 43_1, includes: negative input AND gates 45, 47 and 49 and 51; 53 is a logical OR; 55 and 57 are D flip flops used to store signals; and 59 (128μs One Shot) is a leading edge pulse generator having a 128μs pulse). Veto circuit 43_1, also includes an enable/veto switch 61. Except for enable/veto switch, veto circuits 43_2-43_n (wherein $_n$ is the total number of pods) are identical to veto circuit 43_1.

Figure 2 shows the interconnections between the veto circuits 43_1-43_n (where, again, $_n$ is the total number of pods or modules) for each pod 31_1-31_n and the connection between each veto circuit and OR circuit 71, which combines the output of all the veto circuits. The combined output signal from OR circuit 71 goes to a commercial coincidence logic to register

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